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Beroe abyssicola Mortensen, 1927: a redescription

MARY NEEDL[illegible][1]

Abstract: Examination of a collection of *Beroe abyssicola* Mortenson, 1927 from the central Strait of Georgia largely confirmed the original description. The species can be distinguished by diverticulae of the meridional and pharyngeal canals, comb-rows of equal length extending less than two-thirds of body length even in mature specimens, and gonads in enlarged bases of the meridional diverticulae. The population mode in March to May was found to lie below 200 m.

KEY INDEX WORDS: *Beroe*, ctenophora, depth, population, taxonomy.

Introduction

The many beroid varieties which have been described throughout the world have led to a very tangled taxonomic situation. Undoubtedly, many are synonymous (Harbison and Madin 1982). Vague descriptions and very poor preservation of fixed specimens have aggravated the situation as is true of many fragile ctenophoran species (Harbison et al. 1978). Recently a re-examination and comparison of the better known species has begun. The present re-examination of *Beroe abyssicola* is a further contribution to that comparison.

Beroe abyssicola Mortensen, 1927 was originally described from "several" specimens collected June and July 1915 from the central Strait of Georgia from about 300-400 metres. Mortensen described "ribs" of about equal length reaching only halfway to the oral edge in the largest specimens, meridional and pharyngeal canals with diverticulae but no anastomoses (union) between diverticulae, and enlarged bases of the meridional diverticulae containing gonads in the largest specimen (7 cm long). Small specimens were almost colourless, but living larger specimens each possessed a deep claret pharynx and more scattered pigment along the polar branches and comb plates. Berkeley (1930) collected specimens in winter and spring from below 270 m and showed that the red colour of the pharynx was due to red flagellates. Kramp (1942) re-examined Mortensen's specimens and confirmed the distinction between *B. abyssicola* and red *B. cucumis*, but did not add further details. Greve et al. (1976) examined three *Beroe* collected from the Strait of Georgia and found that one, identified as *B. abyssicola*, had unconnected meridional diverticulae (mistakenly termed anastomoses in their text). Mackie and Mills (1983) and Mackie (1985) using the submersible PISCES IV observed red *Beroe*, probably *B. abyssicola*, in the deep aphotic zone of various inlets with a peak abundance near 300 m.

In connection with a survey of hydromedusae of the central Strait of Georgia (Arai and Mason 1982) over 250 *Beroe* were obtained. Most were poorly preserved but anatomical characters where observed in approximately 80 (not all characters in all specimens). A further 8 specimens were examined and photographed while still living. The results amplify and largely confirm Mortensen's description and support the opinion that *Beroe abyssicola* is indeed a separate, valid species. They also add quantitative data on spring and summer depth and abundance.

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Materials and Methods

Oblique and horizontal daylight tows were made by non-closing, 350 μm bongo samplers. Data from horizontal tows were corrected for depth using the angle of the wire and to a standard volume of 1000 m^3 using flow meters. Specimens were fixed in formalin buffered in sodium borate.

Four series of horizontal tows were carried out March to May of 1979 at the main collecting site, 49° 16′ N, 123° 40′ W. A single series of tows was also made in July 1980. An additional horizontal series was obtained in April 1979 at 49° 16′ N, 123° 49′ W. These sites are both north of Gabriola Island in the area running southeast from Texada and Lasqueti Islands which exceeds 300 m in depth (see map Fig. 1, Arai and Mason 1982). Live specimens for photography were obtained July 27, 1977 by a 400 m vertical tow in this same area. In the springs of 1979 and 1980 oblique hauls to within 10-20 m of the sea floor in a sampling grid (5-6 km interstation distance) covered the Strait of Georgia from Lasqueti Island to Boundary Pass and provided additional specimens.

Five live juvenile specimens were dipped from surface water after a storm at Schooner Cove, off the Strait of Georgia June 29-July 5, 1984 and subsequently fixed in 4% formalin buffered with excess magnesium carbonate.

Results

The following characters were examined for possible taxomonic significance:

1. Colour. As noted by Mortensen (1927) the most conspicuous feature of the species is the intense claret colour of the pharynx in larger living specimens. However, this colour is lost in preserved specimens and as Mortensen also noted, young specimens may appear almost colourless. In the present study living specimens collected 1977, 1.4-3 cm long, each had a dark red pharynx and more scattered red pigment elsewhere, particularly at the bases of the comb rows and polar fields. Two 8 mm specimens had only very scattered pharyngeal pigmentation and a single 1 cm specimen was less deeply coloured than larger specimens. Juvenile specimens collected 1984, 1.23-1.65 cm long, only had scattered pigmentation, particularly along the meridional canals, polar fields, and at the edge of the mouth, giving a general impression of very slight pink. Berkeley (1930) showed that the colouration is due to red flagellates. Variation in colour is also found in other species of *Beroe*, for example Kramp (1942) found *B. cucumis* off Greenland with the same intense claret colour whereas in most locations *B. cucumis* is light pinkish or lilac. Again larger specimens were intensely coloured and small specimens colourless. Colour is therefore of little taxonomic significance.

2. Shape. Living and fixed animals have a sack shape with rounded aboral end. The pharynx is solid. However body proportions are very variable in fixed specimens. Width (measured in the pharyngeal plane halfway along the length) varies from equal to less than half of body length in fixed specimens (Fig. 1). Mouth width also varies highly, from more than two-thirds to less than a fifth of body length in fixed specimens (Fig. 2). Animals often contract strongly during fixation. In five animals where this contraction was noted fixed length in buffered formalin varied from 95% to 45% of that in the living animal. Mortensen (1927) noted a living specimen 7 cm long whereas following fixation in chromosmic fluid the

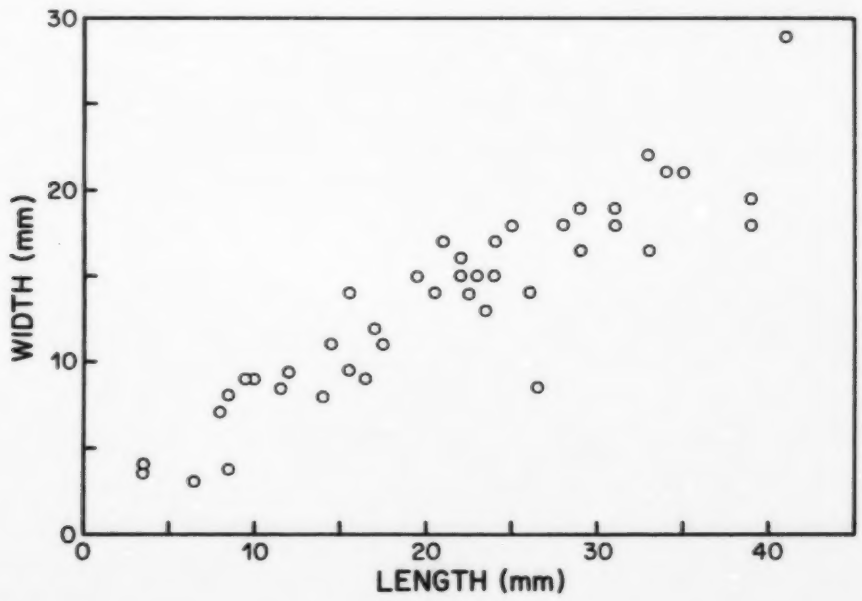

FIGURE 1.

Width (in pharyngeal plane half way along length) versus length of *Beroe* fixed in formalin buffered with sodium borate.

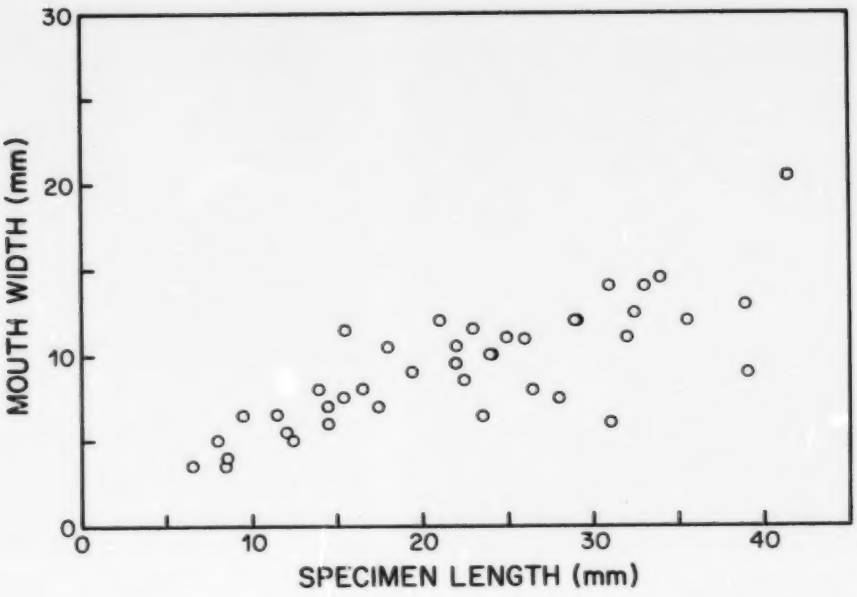

FIGURE 2.
Mouth width versus specimen length of *Beroe* fixed in formalin buffered with sodium borate.

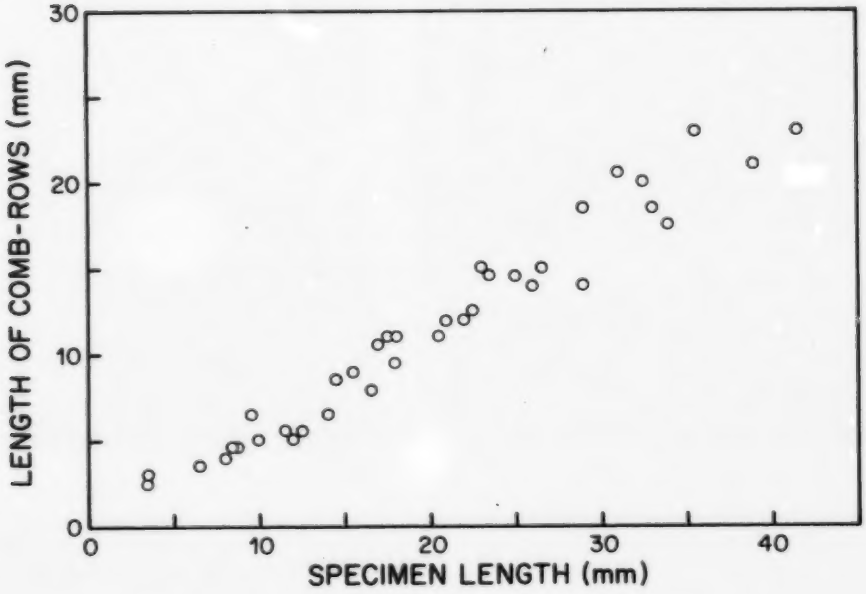

FIGURE 3.
Length of comb rows versus length of *Beroe* fixed in formalin buffered with sodium borate.

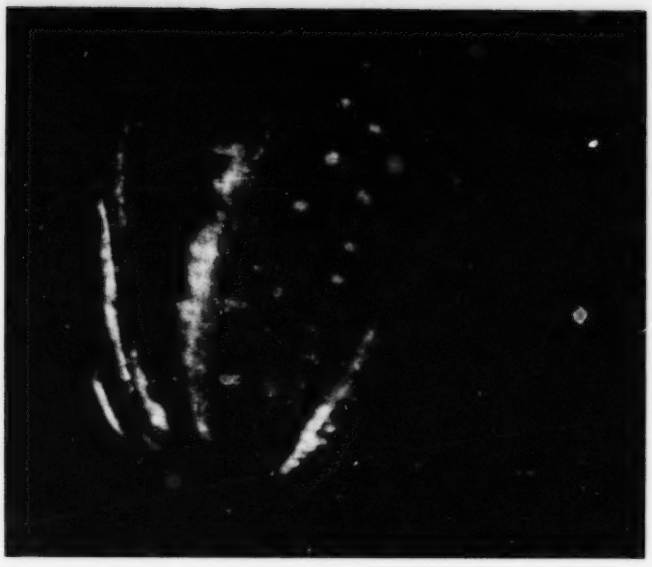

FIGURE 4.
Aboral portion of a small *Beroe abyssicola* to show unbranched diverticulae of the meridional canals. 10 mm long, living specimen.

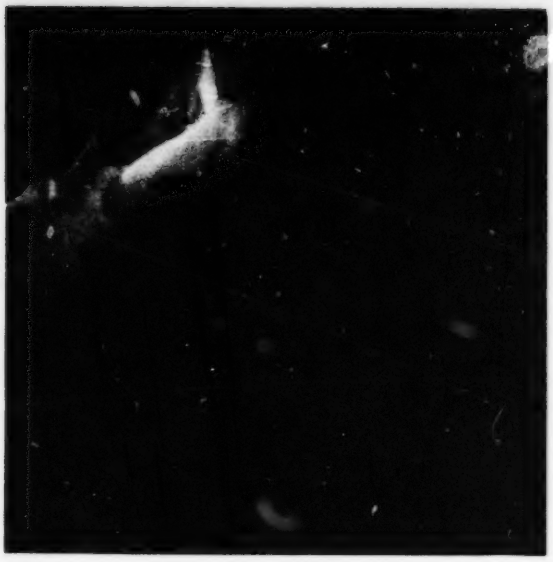

FIGURE 5.
Oral portion of a *Beroe abyssicola* to show branched diverticulae of the meridional canals. 22 mm long, fixed specimen.

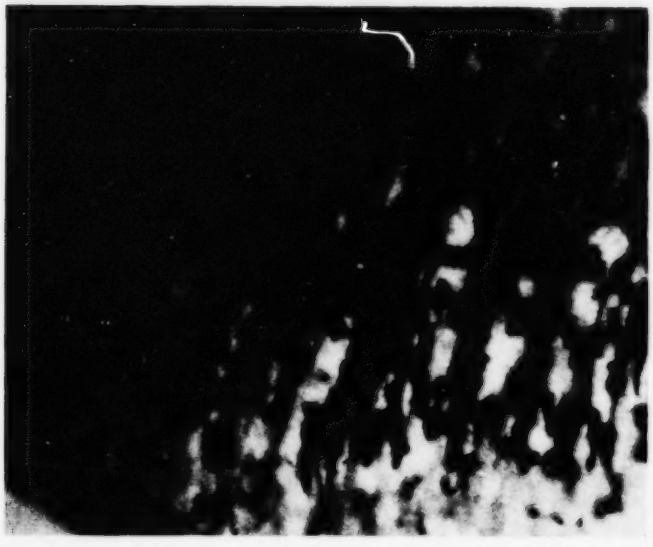

FIGURE 6.
Beroe abyssicola specimen from which the outer layers have been stripped to show pharyngeal canals and diverticulae. 26 mm long, fixed specimen.

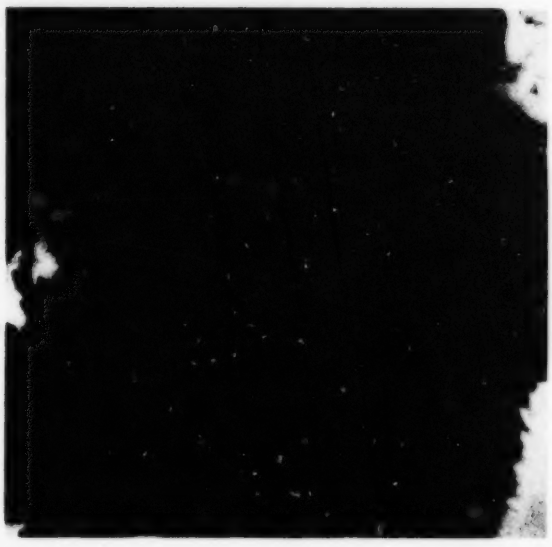

FIGURE 7.
Aboral portion of a *Beroe abyssicola* to show the expanded bases of the diverticulae of the meridional canals which contain the gonads, approximately 40 mm long, fixed specimen.

specimen was approximately 4.2 cm (his Fig. 1b). The longest fixed specimen measured in the present study was 4.1 cm. While careful use of anaesthetics may improve the preservation shape does not seem to yield useful characters for routine identification.

3. Comb rows. Mortensen (1927) described the "ribs" as "of about equal length: in the largest specimens reaching only about halfway." In the present study the comb rows were of a surprisingly stable proportion of specimen length. They varied from slightly less than half to two-thirds of body length in fixed specimens 5 mm to over 40 mm long i.e. until after maturity (Fig. 3). They were of approximately equal length in each specimen. Both of these appear therefore to be useful characters.

4. Meridional canals. Mortensen (1927) stated that the meridional vessels are "richly proliferating" but no anastomoses are formed. In the present study all specimens had meridional canals with diverticulae, simple or partly branched in small animals (Fig. 4), becoming branched in specimens over 15 mm in fixed length (Fig. 5). Diverticulae do rarely form anastomoses with other meridional diverticulae when branches interdigitate. Therefore it is not possible to make an absolute distinction from species in which such anastomoses are commonly present. However the presence of diverticulae of the meridional canals is a useful character vis a vis some other species which lack diverticulae.

5. Pharyngeal canals. Mortensen (1927) stated that the pharyngeal vessels are "usually richly proliferating with close set, rather thick branches: there is however, much variation in the number of the proliferations...; in no case the pharyngeal vessels were found to lack proliferations entirely. No anastomoses between pharyngeal and meridional proliferations were observed." All specimens in the present study (Fig. 6) had diverticulae of the pharyngeal canals. This is a clear cut distinction from many other species. It can be checked even in most poorly preserved specimens. The diverticulae pass under the subtentacular meridional canals without anastomoses. However in larger specimens branches from the pharyngeal canals may anastomose with diverticulae of the substomodael meridional canals or with other pharyngeal diverticulae. Diverticulae are often filled with shiny droplets postulated to contain lipids.

6. Gonads. Mortensen (1927) stated that "in the largest specimen the basal part of the proliferations was found to be enlarged and to contain the gonads... only few ripe eggs being found, while the spermatozoa were fully ripe. The size of the eggs was ca. 0.05 mm." In the present study bases of diverticulae at the aboral ends of the meridional canals (to slightly beyond the comb rows) are enlarged in larger specimens (Fig. 7). In one specimen small eggs could be seen in the expanded diverticulae on one side of the meridional canal. The rare development or preservation of eggs makes egg size a poor character but the presence of gonads in the enlarged bases of the diverticulae rather than in the walls of the meridional canals is clear.

Figure 8 shows the depth distribution of *Beroe* from horizontal tows at 49° 16′ N, 123° 40′ W in March to May of 1979 and July 1980. Although the population mode was below 200 m, specimens were collected up to 150 m depth. Similarly horizontal tows at the same station on April 30, 1979 obtained specimens at 151 m but the population mode was again below 200 m. In oblique hauls specimens were only once obtained at stations of less than 180 m depth.

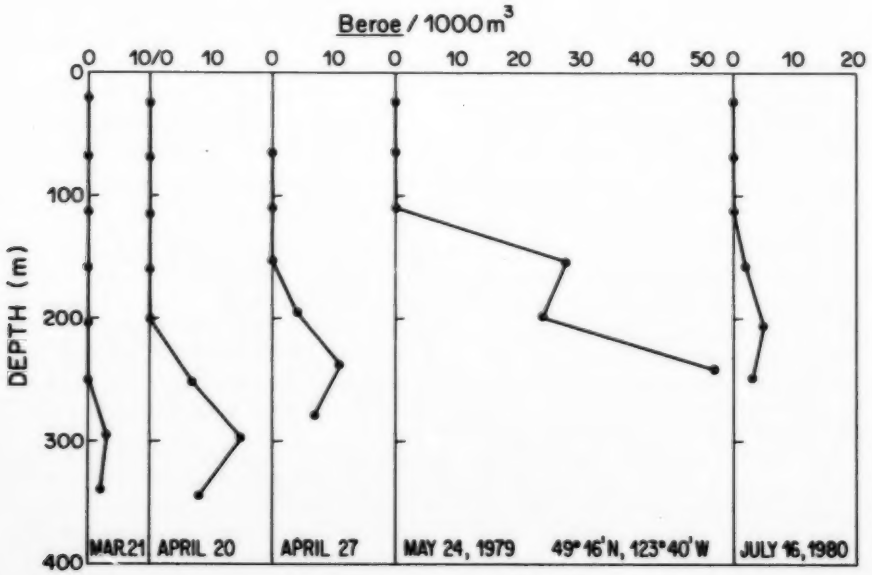

FIGURE 8.
Depth profile of *Beroe* spring 1979 and July 1980 at 49° 16′ N. 123° 40′ W.

Discussion and Conclusions

The results confirm the original description of *Beroe abyssicola* by Mortensen (1927) with the following minor exceptions: the "ribs" may extend beyond one half to almost two-thirds of body length in some specimens, anastomoses of diverticulae of the meridional and pharyngeal canals were observed in larger specimens, and specimens were collected up to 150 m depth. *B. abyssicola* can be distinguished from other species of the genus by diverticulae of the meridional and pharyngeal canals, comb-rows of equal length, extending less than two-thirds of body length even in mature specimens, and gonads in enlarged bases of the meridional diverticulae.

Idyia cyathina L. Agassiz, 1860 was described from the Strait of Georgia (L. Agassiz 1860, A. Agassiz 1865) prior to Mortensen's 1927 description of *B. abyssicola*. However, it was too incompletely described to definitely synonymize with *B. abyssicola*. Certainly it is not a synonym of *B. cucumis* as assumed by Moser (1908) and Mayer (1912) but rather another species as suggested by Mortensen (1912). It resembles *B. abyssicola* in shorter "rows of flappers" and gonads in "much longer sacs" but no other useful data is given.

In NE Pacific waters *Beroe cucumis* Fabricius, 1780 has been collected off Oregon, Friday Harbor, Vancouver Island and Alaska (Torrey 1904, Pearcy 1972, Takeuchi 1972, Mills 1981). *B. cucumis* can be easily distinguished from *B. abyssicola* by its simple, unbranched pharyngeal canals and less solid pharynx. In larger specimens it is also distinguished from *B. abyssicola* by longer "ribs", and gonads in the walls of the meridional canals rather than in diverticulae.

There is probably at least one other species of *Beroe* present in the north-east Pacific. Mills (1981) described a *Beroe* sp. from Friday Harbor that was small and slender with only a few diverticulae. Greve et al. (1976) found two specimens of 10 and 16 mm in the Strait of Georgia which showed no diverticulae. I have not found such specimens in the present study of the central Strait of Georgia.

Elsewhere there have been many beroid species described with varying degrees of accuracy and detail (for descriptions and reference to previous literature see Moser 1908, Mortensen 1912, 1927, Mayer 1912, Bigelow 1912, Komai 1918, 1921, Kunne 1939, Kramp 1942, Ralph 1950, Greve 1975 and Greve et al. 1976). *B. abyssicola* can be distinguished from a number of these, such as the well known *B. gracilis* Kunne 1939, by the diverticulae of the pharyngeal canals, a character which is obvious even in poorly preserved or immature specimens. In this character and the presence of the gonads in enlarged bases of diverticulae of the meridional canals *B. abyssicola* most closely resembles *B. forskalii* (Milne Edwards, 1841). However *B. abyssicola* differs from *B. forskalii* in the shorter comb rows, less extensive anastomoses of the diverticulae and smaller size of mature specimens. It is possible that some of the incompletely described specimens assigned to *B. forskalii* from other parts of the Pacific may belong to *B. abyssicola*.

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